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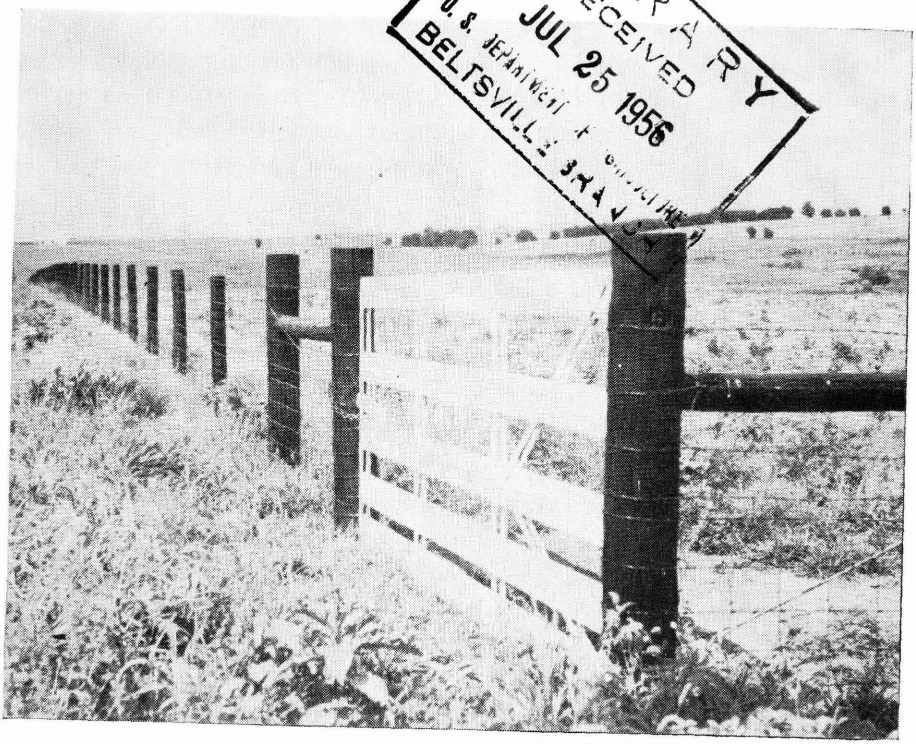
Preservative Treatment of Fence Posts and Farm Timbers



Farmers' Bulletin No. 2049
U. S. DEPARTMENT OF AGRICULTURE

This bulletin aims to give the farmer a clear picture of the different chemicals and different treating methods he can use to protect his fences and wooden buildings against decay and termite attack. Enough facts are given about termites and wood rot to help understand and control both. Because the replacement of untreated fence posts is more of a day-to-day trouble to the farmer than the deterioration of most other farm structure units, the bulletin places chief emphasis on fence posts. Other forms of timber, which can be given the same treatments, are also considered.

All the common preservatives are described and an idea given of their worth for different purposes. The best treating methods are also described. Which one to use will depend partly on the kind of wood being treated, as well as on the time and money the farmer has to spend on treating work. Savings to be made through on-the-job treatment will depend generally on the effort put into it. The farmer will be able to decide whether, in his own case, preservative treatment will pay and what treatment will be best for him.

This bulletin supersedes Farmers' Bulletin 744, The Preservative Treatment of Farm Timbers.

Washington, D. C.

Issued September 1952

Slightly revised April 1956

PRESERVATIVE TREATMENT OF FENCE POSTS AND FARM TIMBERS

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INTRODUCTION

SHOULD YOU TREAT your fence posts? The answer will probably be "Yes" for most farmers. Of course, if you can get enough posts of rot-resisting species at a reasonable cost, then you probably will not need to treat. Most farmers, however, are not so fortunate.

Most farmers spend a lot of time, and frequently considerable money, replacing rotting posts. For instance, Virginia farmers, their extension forester estimates, cut and set about 10 million fence posts each year. Most of these are used in repairing and rebuilding fences. A well-built wire fence will last 20 to 25 years. If the posts can be made to last that long, instead of needing replacements every 3 to 7 years, both cash outlay and labor will be saved.

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[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Acknowledgment is made of illustrations furnished for use in this bulletin by the Forestry Department, University of Illinois, Urbana, Ill., and by the Wood Preserving Division of the Koppers Co., Pittsburgh, Pa.

Treated posts are the answer. Posts can be made to last, on an average, from 10 to 30 years, depending on the type of treatment and species used. Some posts have been known to last more than 50 years.

Pressure-treated posts will usually give you the longest possible life. These you will have to buy, however, and that requires an immediate outlay of cash. You can, of course, treat your posts yourself.

What treatment you pick will depend on your individual situation. Do you hire help or do you do most of your own work? Are you—and your hired hands—able to take the time to treat posts?

Do you live in a dry area where experience shows that posts deteriorate very slowly in the untreated tops? Are you planning to use posts mostly of heartwood with moderate decay resistance? In such cases butt treatment only will probably be adequate for your purpose.

The following tabulation shows about how long round, untreated fence posts of different kinds, with normal sapwood thickness (fig. 1), 5 to 6 inches in diameter, should last on an average:[2]

2 to 7 years		*7 to 15 years*
Ash	Honeylocust	Baldcypress
Aspen	Larch	Catalpa
Balsam fir	Maple	Cedar
Basswood	Oak (red)	Oak (white)
Beech	Pine	Redcedar (eastern or western)
Birch	Spruce	
Boxelder	Sweetbay	Red mulberry
Butternut	Sweetgum	Redwood
Cottonwood	Sycamore	Sassafras
Douglas-fir	Tamarack	
Elm	Tupelo, black	*Over 15 years*
Hackberry	Willow	Black locust
Hemlock (eastern)	Yellow-poplar	Osage-orange
Hickory		

In the case of ash, birch, and a number of other woods named in the tabulation, several kinds or species of the same wood are covered by one name—for instance, sugar, soft, and all other maples under "maple." The life of posts of most of these woods, especially those in the 3- to 7-year group, can be doubled or more by treating the posts with a preservative.

In any case, there are enough worth-while treatments and enough good preservatives to make it difficult to choose a treatment and preservative. The advertising of commercial or "patented" preservatives and processes also helps to make the choice harder. Sometimes the formulas are secret and they are sold for a high price. To make them look cheap you may be urged to use them only for brush-on treatments or for brief dipping of posts. Such treatments call for very little preservative, but they also do very little good.

[2] The periods covered by each group in the tabulation are quite broad—2 to 7 years, 7 to 15 years, and over 15 years. More definite values cannot be given because of the variations in size of posts, amount of sapwood (fig. 1), and soil and moisture conditions. Larger posts or split posts having little sapwood should last longer than the figures given here for 5- to 6-inch posts. Smaller posts, mostly of sapwood, would not last as long.

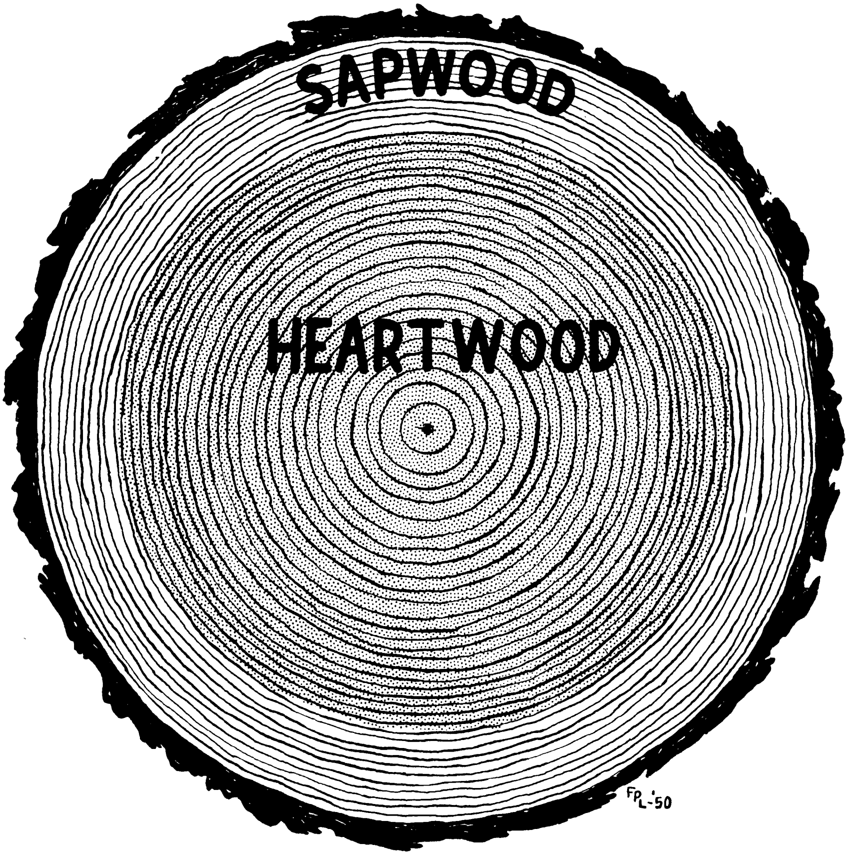

FIGURE 1.—Diagram of heartwood and sapwood zones on the end of a post.

The job of picking a post treatment that will be best for you should be made easier by considering the points presented here concerning decay and how it can be stopped, what a preservative is and some of the dangers involved, the types of treatment that can be used, and the kinds of preservatives available.

THINGS YOU NEED TO KNOW

Decay and How to Stop It

Decay is another name for rot. Rotten wood is a familiar sight wherever trees grow. You can spend a lifetime studying decay, but you need to know only a few facts to fight it.

Decay is caused by low forms of plant life called fungi (fig. 2). The "seeds" of these growths—called spores—are too small to see and they can float in the air for long distances. If the spores fall on wood that contains enough moisture, they germinate and the tiny threadlike filaments grow on or into the wood. The wood decay fungi destroy the wood by breaking it down chemically. In due time the fungus forms spore-producing bodies on the surface.

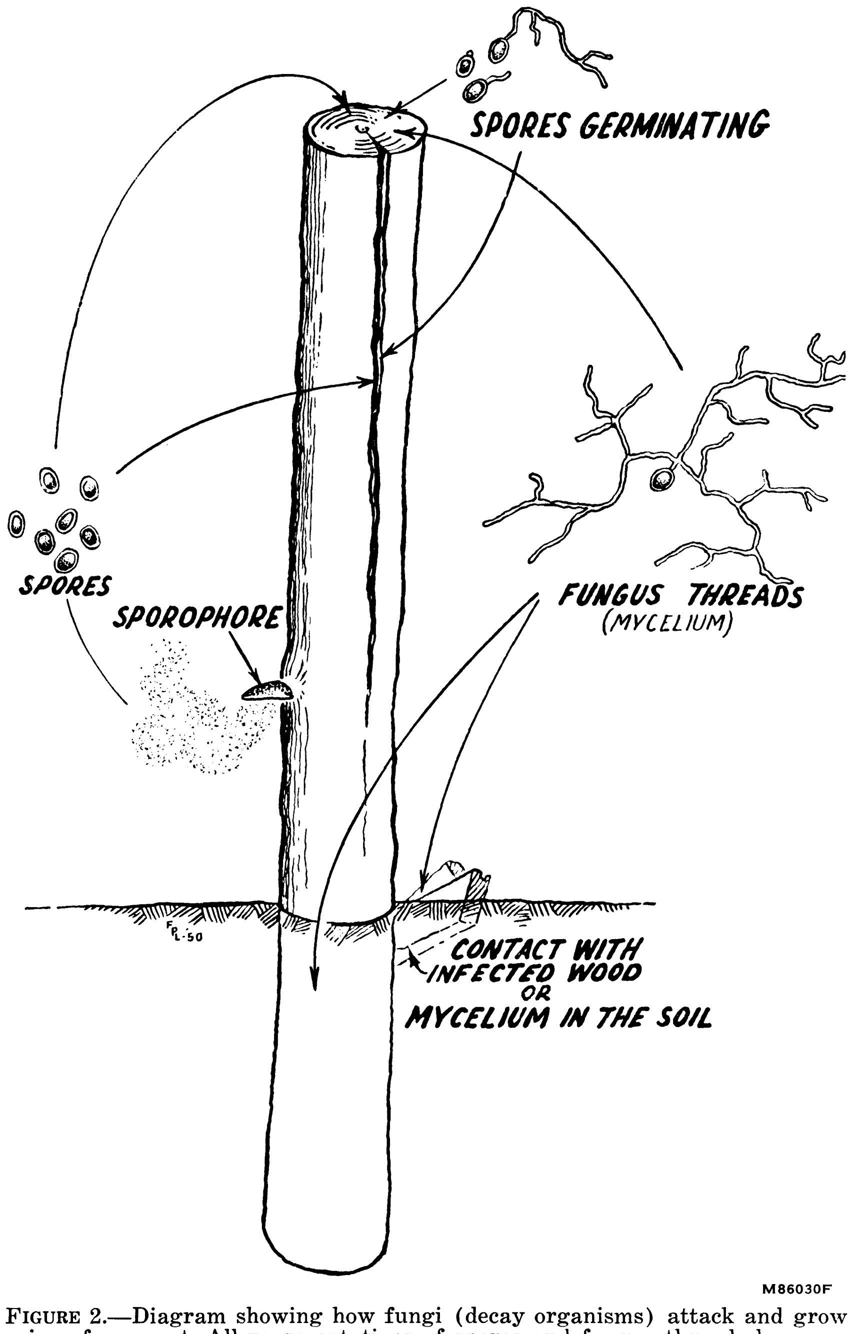

FIGURE 2.—Diagram showing how fungi (decay organisms) attack and grow in a fence post. All representations of spores and fungus threads here are greatly enlarged. In dry areas, such as parts of the Rocky Mountain region, moisture conditions do not favor the development of fungi in the tops of posts.

There are many names for these spore-bearing bodies. You may know them as "toadstools," "punks," "conks," "brackets," or "dog-ears." When these easy-to-see parts of the growth have formed you know that the wood may be already badly rotted.

Like most other forms of life, decay fungi must have four things to live—air, moisture, a favorable temperature, and food. If you take away one or more of these four needs, you can stop decay.

There's not much use in talking about taking away the air. Wood under water won't decay nor will wood buried far enough—2 or 3 feet isn't deep enough—underground. But only a few uses of wood involve such conditions.

Nor is it very practical, in the places where you want to use wood, to keep it too hot or too cold to decay. Decay fungi will grow at surprisingly low temperatures as well as at fairly high temperatures.

Wood can be kept too dry to rot in many but not all indoor uses. Even many outdoor structures can be planned so that wood dries out quickly after a wetting and before decay fungi can start to grow. But where wood is in actual contact with the ground it is impossible to keep it too dry to decay.

The remaining thing that can be done to stop decay—and especially decay in wood resting on or in the ground—is to poison the food supply. The "food," of course, is the wood itself. The wood can have preservatives put into it—poisonous chemicals that will either kill the decay fungi outright or keep them from growing.

Termites

Termites, sometimes mistakenly called "white ants," are insects causing damage to untreated wood when it is used either in contact with the ground or not adequately insulated from the ground. Subterranean or ground-nesting termites, the most common type in the United States, have been found in every State although their damage reaches most serious proportions in the area south of a line through Massachusetts and southern New York, south of the Great Lakes and extending to the Pacific coast south of Oregon. They are most abundant in moist, warm soil with a plentiful supply of food in the form of wood or other cellulose material. Treatments with preservatives that are effective in preventing decay in wood are also effective in controlling attack by termites.[3]

What Is A Preservative?

A wood preservative is a chemical substance that is poisonous to decay fungi. To have any practical value it must be of a consistency to penetrate wood well and it must be fairly cheap. Also it should not corrode nails or other fastenings. It should not

[3] Information on the control of termites in buildings is available in Farmers' Bulletin No. 1911, Preventing Damage to Buildings by Subterranean Termites and Their Control, which can be obtained from Office of Information, U. S. Department of Agriculture, Washington 25, D. C.

evaporate too easily or too easily wash out of the wood. A preservative for farm use should not be dangerous in small concentrations to farm animals or to persons working with it.

These are the simplest needs in a fence post preservative. For use in other timber on the farm a preservative may need to be clean, paintable, or perhaps free from objectionable odor.

How Dangerous Are Preservatives?

Wood preservatives by their very nature are toxic materials and are therefore harmful to human beings and domestic animals if taken internally in substantial quantity. Some persons with very sensitive skin suffer considerable skin irritation from relatively casual contact with creosote, pentachlorophenol, or other preservatives. Such cases are in the minority. Preservatives generally should be of such character that only ordinary precautions are required to avoid harm to the majority of those who handle them around wood-preserving operations. They must be harmless to those who come in contact with the wood after it is treated.

Things That Will Not Help

A number of things that are sometimes tried to make wood last longer do not work out.

There is no proof that you can depend on charring posts. It has been known to help in some cases. But in others it has failed to give any protection against rot.

Piling stones around posts helps to keep back weeds and in that way makes for more air movement around the post in an area above the ground level. It may also protect against "burning" by drifting sand in regions where this is going on. But the stones may hold moisture at the ground line and so make decay worse.

Setting posts in concrete or thinly coating posts with concrete cannot be depended on either. Once water gets between wood and concrete or through a crack in the coating the concrete only serves to hold moisture and the wood will rot faster.

Beveling the tops of posts to a sharp edge so that snow and rain can readily drain off looks like a good idea. However, there seems to be little definite proof that it actually prolongs the life of a post enough to notice.

Asphalt is not a preservative and its application alone will not add significantly to the life of posts.

The Cost That Counts

The yardstick of success in the use of fence posts, especially treated fence posts, is the cost per post per year. By this standard the treatment (or perhaps the use of high durability woods without treatment) that costs the most in the beginning may be the cheapest in the end (fig. 3). First, add the cost of all the posts treated to the cost of preservative, labor, and equipment (you may want to charge some of the cost of equipment to future treating) and divide by the number of posts. What you have now is an average first cost per post. Add to this the cost of installing the

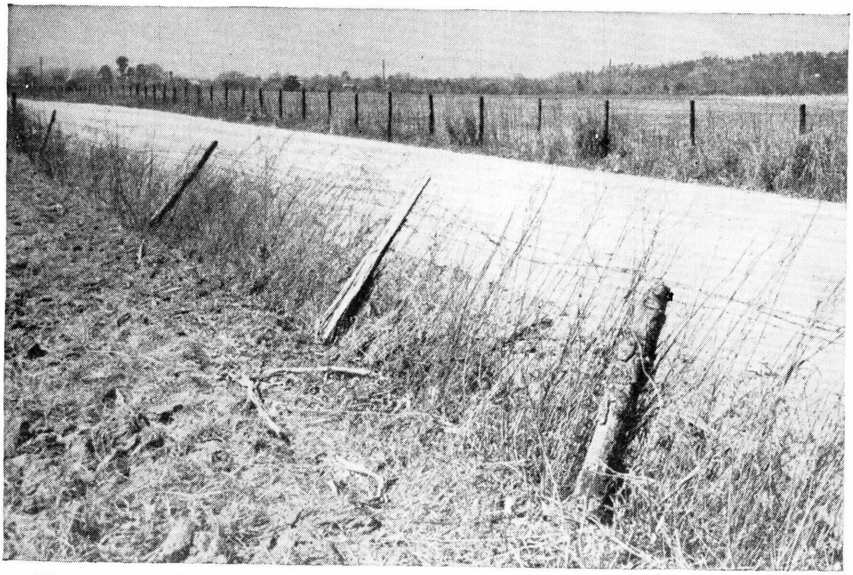

FIGURE 3.—The posts in the foreground were not treated; those in the background were pressure treated with coal-tar creosote.

post and divide the resulting figure by the number of years of expected service and you have determined your cost per post per year, not including interest on the investment.[4]

PRESSURE-TREATED POSTS

Pressure treatment is the most dependable for fence posts that are required to give long service. This pressure impregnation properly applied with standard preservatives such as coal-tar creosote has been proved, through long experience.

Pressure treating is an industrial process calling for heavy and expensive equipment (fig. 4). Posts are loaded on light cars or trams and run into a long steel cylinder. The preservative is pumped in to cover the posts and pressure is put on until the needed depth of penetration and total take-up of preservative has taken place. This is a very rough description of a process that can be done in a number of different ways.

In 1950 there were 211 wood-preserving plants in operation in the United States using pressure for treating. The plant operators are familiar with American Wood Preservers Association Standard C5 and Federal Specification (TT–W–571c) covering the pressure treatment of round posts with coal-tar creosote and other standard wood preservatives. Since these specifications contain definite requirements as to how deep the preservative must penetrate the wood and how much total preservative by weight must be retained

[4] Forest Products Laboratory, Madison 5, Wis., has available on request Technical Note No. 165, When Preservative Treatment of Wood Is an Economy, which contains a table for computing annual charges with compound interest.

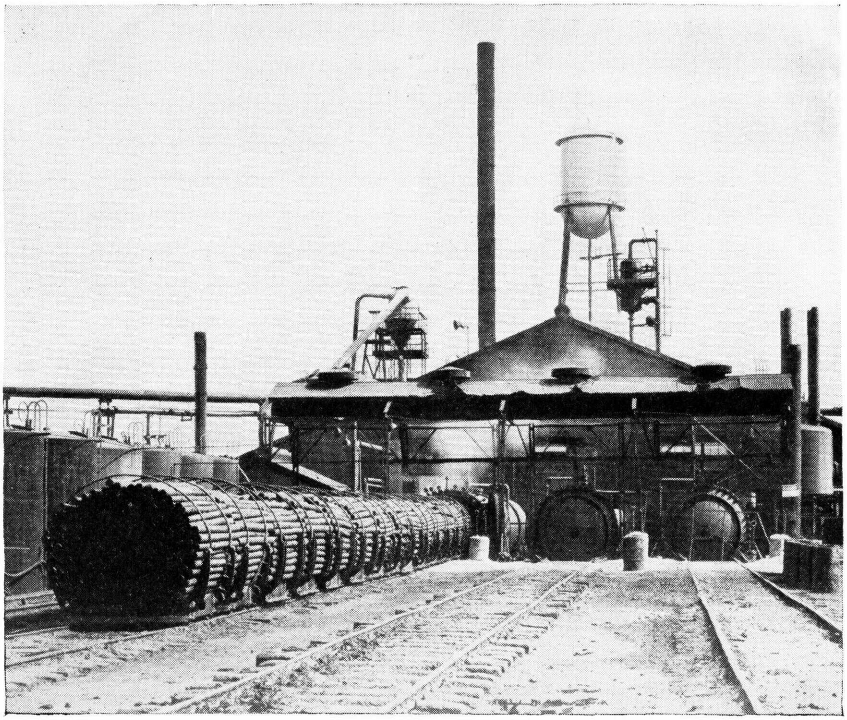

FIGURE 4.—Tram loads of fence posts after pressure treatment at a commercial wood-preserving plant.

by the wood it may be well for you to refer to one of them as a standard when having treating done or buying treated posts. Posts properly treated with coal-tar creosote or its equivalent to meet the specifications should have an average life of at least 30 years.

Posts treated with some of the water-borne (that is, soluble in water) preservatives by the same specification will have a somewhat shorter average life, but they can be painted and the creosoted posts cannot. Oil-borne preservatives other than creosote, such as pentachlorophenol and copper naphthenate, also have characteristics, such as cleanness and paintability, that are advantageous in certain situations, but they have not yet been demonstrated conclusively to be equal to coal-tar creosote in preservative properties.

You will find that pressure-treated posts cost from about 35 cents to a dollar or more ready for use, depending on size, number of posts bought, and how far they have to be shipped. Their cost per year of service will be low, however, because they last so long. Pressure-treated posts are for the man who has ready cash and is willing to invest it in long-lived trouble-free posts.

If you live near a pressure-treating plant you may be able to buy pressure-treated posts direct from the plant. In many places you can buy them from your lumber yard.

In citing service records here and elsewhere in this bulletin, it should be noted that it is possible to predict the average life of a group of wood posts in test on the basis of the percentages of removals during the progress of a test. Experience has shown such estimates to have a good degree of accuracy. Attention is also called to the fact that the performance of any preservative for treatment is influenced not only by the quality of the preservative but by penetrations and retentions obtained. In service records, therefore, poor results may often be traced to poor treatment and resulting poor preservative penetration.

Service records on round southern yellow pine posts carefully pressure treated with 6 to 8 pounds of coal-tar creosote or standard preservative oils per cubic foot indicate that an average life of 30 years or more can be expected in various parts of the United States. Round posts of other species should perform equally well when good penetration of the creosote is obtained. Service tests on 64 installations of various species of posts pressure treated with water-borne preservatives show that such posts have an average life of 19.1 years. The more effective water-borne preservatives protect the posts for a period longer than this average, but others provide less than average life.

The advantages and disadvantages of the use of pressure-treated material can be summed up as follows:

Advantages	*Disadvantages*
Good penetrations.	May not be available in your locality.
Good absorptions.	Outlay of cash.
Long service.	
Infrequent replacement.	
Low cost per post per year.	

HOT-AND-COLD-BATH TREATMENT WITH PRESERVATIVE OILS

Of the treatments that you can do yourself the one that does the most good is the hot-and-cold-bath treatment. The preservatives that can be used include coal-tar creosote, creosote mixtures, and petroleum oils to which have been added pentachlorophenol or copper naphthenate.

For use in most areas of the United States the posts which have a short life without treatment (see tabulation, p. 2) should be treated full length, but in semiarid areas such as the Rocky Mountain region and for woods of fair to high durability used elsewhere the posts need only be treated at the butt end. In such a case the treatment should extend far enough up the post so that at least 6 inches of treated wood will be above the ground line when the post is set. When given a full length treatment and two tanks are used the butts of the posts can be treated in the hot bath and then the posts can be immersed full length during the cold bath.

The hot-and-cold-bath treatment takes time, hard work, and heating equipment which calls for some outlay of cash. It has not proved to be popular for farm use, but for anyone who cares to put out the effort for a good job of treating, it is worth while, for it should make posts that are well treated last 20 years or

longer on an average. Because the treatment calls for so much care and work, it is probably better adapted to the use of groups of farmers working together than to the needs of anyone working alone.

One thing that has held back wider use of hot-and-cold-bath treatment is the danger of fire. Water in the hot oil may cause the flammable treating solution to foam up suddenly and boil over the edges of the tank and into the heating unit to cause a bad fire. The use of a heat exchanger or steam coils from a separately heated boiler, of course, gets away from this difficulty.

To apply the treatment, posts are heated in the preservative for 1 to 3 hours at 180° to 220° F. The lower temperatures and the shorter time are used for smaller posts and for woods easy to treat. The temperature should not be allowed to go above 220° F. at any time, because up to 20 percent of some oils may evaporate at that temperature. There is also the danger that if the temperature gets too high the oil may boil over the sides of the tank, a fire hazard. Lower temperatures should also be employed in heating treating solutions containing petroleum oils of low viscosity and with oils having a low flash point that cannot safely be heated to the higher temperatures.

Following the heating bath the posts are quickly transferred to a "cold" tank of preservative to remain for an hour or more until good penetration of the sapwood is obtained (fig. 5). During the cooling period the height of the oil in the tank needs watching. The oil level will lower as oil is absorbed by the posts. The "cold" bath should be warm enough to liquify and thin the oil thoroughly. A temperature of 100° F. should do. A candy thermometer, usually to be had at a hardware store, can be used to measure temperatures.

Another way is to simply stop the heating and allow the posts and oil to cool together. This method calls for only a single treating tank, but it takes much more time since the cooling period is an over-night or all-day proposition. For treating a few posts daily this works out well enough, since a batch of posts can be heated up and then allowed to cool all day or over night depending on when you find time to do the treating.

In the hot-and-cold-bath process, as in any treatment, it is desirable to have the preservative penetrate the sapwood deeply.

Naturally, the hot-and-cold-bath treatment does not give the chance for careful control of all conditions that standard pressure treating does, the results will not be as dependable, and it is necessary to take pains to get good results. If the oil does not penetrate deeply enough, the duration of one bath or the other, usually the cold bath, must be extended. If the penetration is satisfactory but too much oil is absorbed, the time of the cold or cooling bath can sometimes be shortened without reducing the penetration. Other measures for reducing preservative retention are discussed in the following paragraphs.

Partly seasoned posts or poles require a much longer time for the hot bath than do well-seasoned, dry posts. Air-seasoned or kiln-dried posts occasionally develop a hardened or glazed surface which is difficult to penetrate with preservatives. In such a case

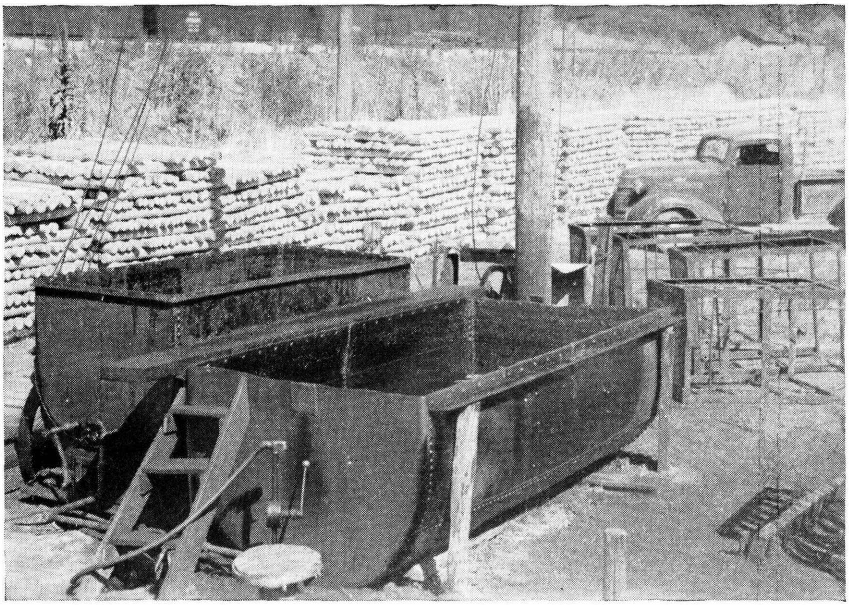

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FIGURE 5.—A simple hot-and-cold-bath post-treating outfit. The nearest tank was made by cutting in half an old boiler.

removal of the hardened surface around the ground line zone with a drawshave will improve the treatment. Incising will also improve the penetrability of surface-hardened posts.

Posts treated by the hot-and-cold-bath process will absorb from 1/3 to 1 gallon (3 to 9 pounds) of preservative per cubic foot of wood treated, depending on the kind and condition of the wood, the thickness of the sapwood, and the weight per gallon of the preservative. Molded and other fungus-infected pine posts, however, have been found to absorb as much as 30 pounds of creosote per cubic foot. It is desirable to aim at a retention of 6 to 7 pounds of preservative oil per cubic foot of wood in a full length treatment (fig. 6). In a butt treatment the wood actually treated (approximately half of the volume of the post) should likewise retain 6 to 7 pounds of preservative.

From a cost standpoint, the principal objection to the hot-and-cold-bath process is that excessive quantities of preservative are often used in order to obtain good penetration. This is particularly the case with poles, posts, and other timbers of woods, such as the southern pines, that have thick sapwood. The following measures, and modifications of the hot-and-cold-bath treatment, are sometimes taken either to reduce preservative retentions or to reduce the cost of the preservative used.

1. To prevent decay, molds, and blue stain the timbers are cut at a favorable time (see page 27) and treated as soon as they have become seasoned.

2. A final heating or expansion bath with the oil at 200° to 220°F. for an hour or two is used after the cold bath. The wood

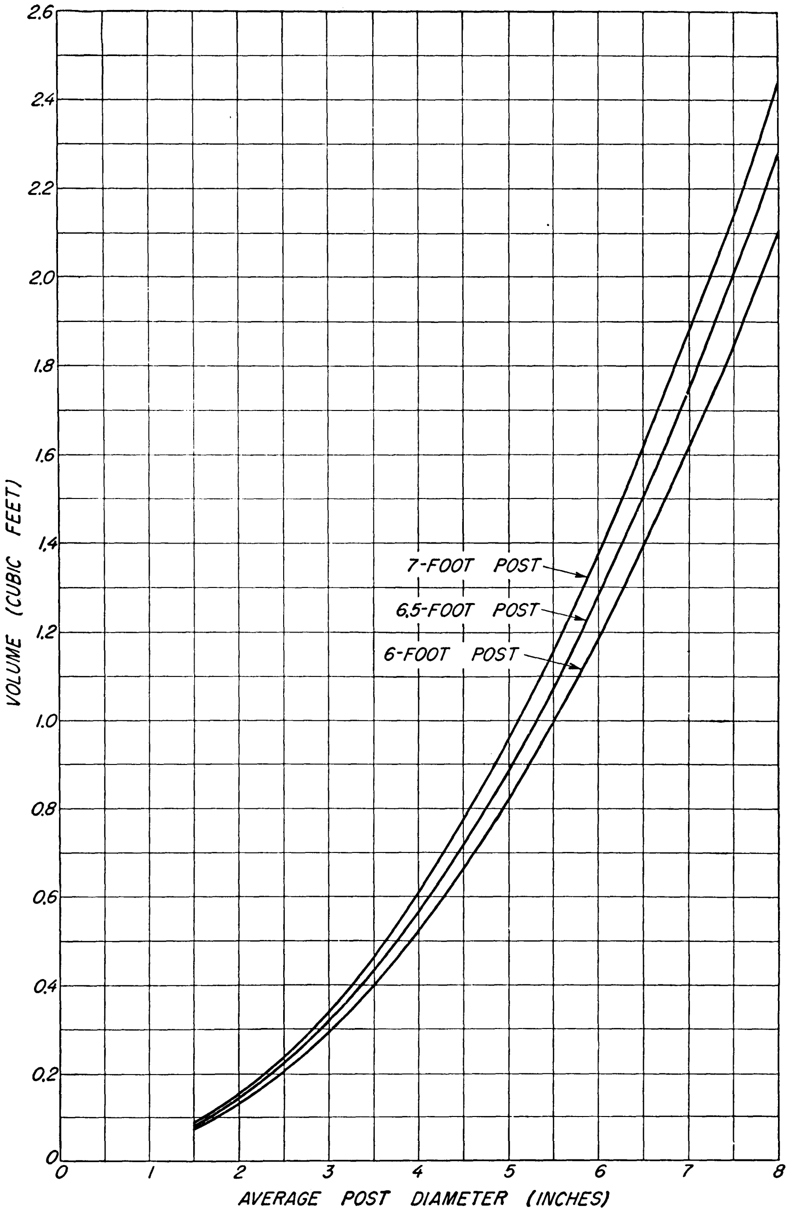

FIGURE 6.—This chart can be used to determine the volume of any post whose average diameter is between 1.5 and 8 inches and whose length is 6, 6.5, or 7 feet. To determine the volume of a given post start with the average diameter—the diameter at a distance half way between the ends. On the line at the bottom find this average diameter and read upward to the point where the vertical line intersects the curve corresponding to your post length. Then read horizontally to the scale at the left-hand edge to find post volume. For example, a post with average diameter of 6.5 inches and 6.5 feet long will be shown to have a volume of 1.5 cubic feet.

is then removed while the oil is still hot and some of the oil is recovered as a result of the expansion of the air and preservative within the wood during heating.

3. Water, 5-percent zinc chloride solution, or steam is used instead of the more costly preservative as a means of heating, and creosote or other preservative oil is used only in the cold bath.

4. Creosote-petroleum solution with a heavy standard grade petroleum is included in American Wood Preservers' Association standards for the pressure treatment of posts, cross ties, and other products. A saving in preservative costs could be made in hot-and-cold-bath treatments through the use of such oils A somewhat questionable practice, in the absence of service records, is the reduction of preservative costs through the heavy dilution of the creosote with light oils such as kerosene. Dilution of creosote with more than an equal amount of petroleum may result in poor performance.

Petroleum oil containing either 5 percent (by weight) pentachlorophenol or a solution of copper naphthenate containing 0.5 percent copper metal can be applied by the hot-and-cold-bath method, although hot bath temperatures may need to be lower for easily ignited petroleum oils than for creosote. American Wood Preservers' Association Standard P9 covers petroleum oils suitable for use in pentachlorophenol and copper naphthenate solutions that are to be used in hot-and-cold-bath treatments.

The hot-and-cold-bath method as described may be found unsatisfactory for use with preservatives that cannot safely be heated to temperatures of 180° to 220°F. It is often true also that excessive quantities of preservative are absorbed in the conventional hot-and-cold-bath treatment. In such cases the process can be modified by heating the posts in steam, hot water, or hot zinc chloride solution instead of in the preservative oil. Heating periods should be of similar duration to those already suggested, 1 to 3 hours for fence posts, following which the posts should be immersed for an hour or more in the cold bath of the preservative oil.

The hot-and-cold-bath modification involving steaming,[5] which is adapted to commercial or cooperative rather than one-man operations, can be used with water-borne preservatives such as zinc chloride or with a number of proprietary preservatives containing components which do not permit heating. The wood to be treated can be placed in the treating tank with a canvas or other suitable cover during steaming. Following steaming, the condensed moisture is removed from the tank and the preservative allowed to run in and completely cover the heated wood.

The heating-in-water adaptation of the hot-and-cold-bath method has been studied by the University of Georgia in an attempt to avoid excessive retentions (net absorptions), simplify operations, and reduce the fire hazard in the treatment of southern yellow pine posts. The experimenters reported retentions of 50-50

[5]Covered by U. S. Patent No. 2,235,822 to A. D. Boardman, March 1941.

solution of coal-tar creosote and No. 2 fuel oil during the cold bath averaging 8.8 pounds per cubic foot and good penetration in air-seasoned southern pine posts. Retentions of a preservative consisting of No. 2 fuel oil containing copper naphthenate are reported to be somewhat lower.[6]

Results in treating southern pine lumber by the Forest Products Laboratory show that enough water is absorbed by the wood during heating to interfere with the penetration and absorption of the preservative during the cold bath and to reduce the protection provided. The use of a 5-percent zinc chloride solution instead of water for the heating bath will help to offset this objectionable feature since zinc chloride has recognized wood preserving properties. Immersion in cold preservative oil should then follow the hot zinc chloride bath. The process appears to have merit where fungus-infected posts have been found to absorb excessive quantities of preservative when treated by the conventional hot-and-cold-bath method.

In 103 different tests of posts of various species treated with creosote and similar preservatives by the hot-and-cold-bath process, the estimated average life of the posts is 24 years. The lowest average figure for individual test settings is 9 years while an average life as high as 50 years is estimated for two of the best installations.

The advantages and disadvantages of the hot-and-cold-bath treatment and its various modifications can be summarized as follows:

Advantages	*Disadvantages*
Most effective nonpressure process when long service is required.	Heating needed, even for cold bath.
Takes less time than other effective nonpressure treatments.	Preservative "messy" to handle.
	Moderately expensive at first.
	Some danger of fire.
	Suitable oil preservatives high priced when purchased in small quantities.

COLD SOAKING

Any method of fence post treatment that calls for a lot of hard, disagreeable work, extreme care in watching the details, and a lot of time for the process is not likely to be popular with farmers. The treating method known as cold soaking is not unduly burdensome either as to work involved, details of treating, or actual operating time. Its cost is in an in-between class and its benefits, so far as proved by service to date, are in the same class.

The groupings in the following tabulation, based on kinds of wood that the Forest Products Laboratory has treated by cold soaking, give an idea of what woods to treat by this method. In interpreting these groupings it should be borne in mind that the treatment gives good results only with seasoned posts and that good or fair retentions do not offset poor penetrations. The poor distribution of the preservative indicated by such a combination would mean only uncertain results with high cost.

[6] More detailed information on this process is given in The Boiling-in-Water Method of Treating Southern Pine Fence Posts, by H. D. White and R. D. Dixon, University of Georgia Bulletin XLIX, No. 8, February 1949.

The results reported for the following groups apply to seasoned posts after a soaking period of 48 hours or longer.

Group 1. *Retentions fair to good, penetrations in sapwood reasonably good.*

Round softwood posts	*Round hardwood posts*
Pine, eastern white	Oak, black (high sapwood content)
Pine, jack	Oak, red (high sapwood content)
Pine, lodgepole	Oak, southern red
Pine, ponderosa	Oak, white
Pine, red	
Pine, southern yellow	

Group 2. *Retentions and penetrations poor to fair.*

Round softwood posts	*Round hardwood posts*
Douglas-fir (coast, inter-mountain and mountain type)	Ash, green
Fir, balsam	Beech, American[1]
Fir, white[1]	Birch, yellow
Larch, European	Butternut
Larch, western	Catalpa
Redcedar, western	Cherry, black[1]
Spruce, black	Elm, American
Spruce, Norway	Elm, slippery
Tamarack	Hackberry
White-cedar, northern	Hickory, mockernut[1]
	Hickory, shagbark

[1] Penetrations in some cases fair to good but not consistently so.

Group 3. *Retentions good, transverse sapwood penetrations generally poor.* (Good end penetration is usually obtained but material over 2 to 3 feet in length could not be expected to show good results.)

Round hardwood posts

Aspen	Maple, soft
Basswood	Sweetbay
Birch, white or paper	Sweetgum
Boxelder	Tupelo, swamp (blackgum)
Cottonwood, eastern	Willow
Maple, hard	Yellow-poplar

The cold soaking treatment consists in submerging posts for 1 to 2 days or longer in coal-tar creosote, solutions of coal-tar creosote and domestic fuel oil, a solution of pentachlorophenol in fuel oil, or a solution of copper naphthenate in fuel oil. Solutions of 5-percent (by weight) pentachlorophenol are used. The copper naphthenate solutions should be prepared to contain a copper metal equivalent of at least one percent (by weight). Copper naphthenate and pentachlorophenol are usually sold in concentrated solutions. Directions for diluting the product to get treating solutions of these concentrations should come with the preservative.

Cold soaking in coal-tar creosote or in creosote-petroleum solutions may not result in satisfactory penetrations of the wood unless the creosote and the oils used with the creosote are applied during warm weather and are thin (low in viscosity). The low-viscosity oils may not perform as well in service as the heavier oils which can be used in treatments involving heating.

Cold soaking calls for a single tank without heating equipment. For woods that treat easily, 48 hours of soaking in low-viscosity preservative oils gives good penetrations of preservative into the

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wood—7/10 to 9/10 as much as you would get with a week of soaking. In most cases soaking more than a week would not be worth while. Cold soaking works best with round pine posts that are well seasoned (fig. 7). Posts of other species and split or sawed posts do not treat so well.

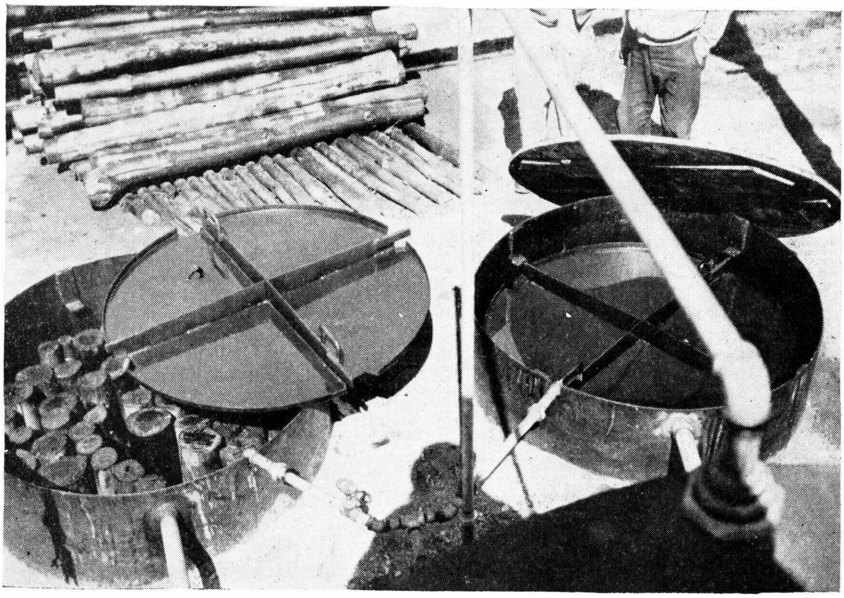

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FIGURE 7.—A small two-tank cold-soaking outfit. The hold-down gear is designed so that a slight turn of the lid-like disk locks it under lugs welded at quarter points on the inside of the tank. Part of the piping arrangement for moving preservative to and from storage tank is in foreground.

Pine posts having a high moisture content (over 30 percent) have been found to be poorly penetrated and to absorb insufficient amounts of preservative. Posts containing surface mold, excessive blue stain, and the beginnings of decay on the other hand absorb too much preservative. With such material the treating time can be reduced to 3 or 4 hours to cut down the absorption of preservative so long as this does not seriously reduce the depth of penetration. It is seldom worth while or economical to treat posts that are rotted.

The preservative for cold soaking may cost 35 to 50 cents a gallon or even more and an absorption of at least half a gallon per post is what you should try for. If you hire labor for treating either by the hot-and-cold-bath method or cold soaking and add the cost of preservative and are obliged to charge the cost of tanks to a fairly small group of posts, the cost of treatment may be almost as much as or more than the cost of pressure-treated posts. The initial cost will be appreciably less if the owner already has a suitable tank or can buy one cheap and then does his own treating.

Posts treated by cold soaking in petroleum solutions containing pentachlorophenol[7] have been in service only since 1942. The posts that have been in service long enough to justify any estimates of service life happen to be those consisting of species to which the treatment seems to be least adapted. Aspen, birch, and cottonwood posts in 13 installations are estimated to have an average life of 7.0 years in comparison with 4.1 years for untreated posts of the same species.

Tests have been running somewhat longer in the case of posts treated with straight coal-tar creosote by cold soaking. In 6 installations of basswood, elm, cottonwood, and red oak posts treated and installed in 1909 the average life of the posts is 23.2 years. The average life of untreated posts of these species is 7.1 years.

The advantages and disadvantages of cold soaking can be summarized as follows:

Advantages	*Disadvantages*
Can be done on the farm.	Moderately expensive at first.
Equipment simple.	Pentachlorophenol solutions irritating to skin.
Moderately effective.	Should be limited to selected species.
No heating equipment required.	Preservative expensive when bought in small quantities.
Moderate cost per post per year.	

PROPRIETARY TREATING METHODS

The ability of preservatives to diffuse into the water of green or wet wood is utilized in various proprietary treating methods. In one of these, green or moisture-soaked peeled wood is brushed or dipped in a thick mixture of the preservative in water and then close-piled and covered tightly with moisture-resistant paper to retard drying. After a few weeks or months the preservative becomes diffused into the sapwood to a considerable extent and to a lesser degree into the heartwood. In service tests on posts treated full length by this method round southern pine posts in Mississippi are estimated to have an average life of approximately 21 years while square or sawed pine posts in Mississippi and round aspen posts in Wisconsin are giving somewhat poorer results. Information on this process is given in the Forest Products Laboratory mimeographed memorandum "The Osmose Preservatives and Processes."

TREATMENTS OF LOW FIRST COST

There are cheap and simple treatments that may be within the range of what you can handle, but they will not make posts last so long as will the three treatments already described. If you cut your own posts, have no help, and want to spend as little cash as

[7] Since so many treatments and preservatives are described in this bulletin there is not space to give all the information you may need on any one of them. More details on the cold soaking treatment are available in Report R1445, Treating Wood in Pentachlorophenol Solutions by the Cold-Soaking Method, which may be obtained free of charge from Director, Forest Products Laboratory, Madison 5, Wis. Report R149, Wood Preservatives, can also be requested.

possible, you may be willing to settle for a shorter post life—just so the treatment saves you money and work in the long run.

If so, preservatives such as water solutions of zinc chloride or chromated zinc chloride may work best for you, since the dry chemicals cost only 8 to 20 cents a pound and a pound will usually take care of one post. These chemicals are fairly clean to handle and are not dangerous to people or animals. They can be bought in dry form and mixed with water just before use, so that you get away from heavy freight charges. They can also be bought in the form of strong water solutions that call for extra water before using. These are easier to use and store than the dry form and may be practical where the freight haul from the supplier to you is not too long.

End-Diffusion Treatment on Green Unpeeled Posts

The end-diffusion or trough method of treating with zinc chloride is quite simple and has been given considerable study by the South Carolina Agricultural Experiment Station at Clemson College, the Forest Products Laboratory, and others. It consists in standing freshly cut unpeeled posts in a tub or other container into which you have poured a measured quantity of 15- to 20-percent zinc chloride solution or chromated zinc chloride solution. Copper sulfate is sometimes used but it is not recommended because it is highly corrosive to staples and fencing wire and has not done as well as zinc chloride in service.

About 5 pounds or approximately 1/2 gallon of 20-percent (by weight) zinc chloride solution is recommended for each cubic foot of post treated (fig. 6). The posts are allowed to stand with the butts down in the solution until approximately three-fourths of the solution has been absorbed—which may take from 1 to 10 days or longer. After treating with butts down the posts are turned over, and the tops are allowed to absorb the remaining solution. They are then stored for at least 30 days with the tops down to permit distribution of the preservative within the post before it is set in the soil.

The South Carolina Agricultural Experiment Station reports that the treatment works well with southern pine posts. The Forest Products Laboratory in Wisconsin has obtained fair to good penetrations and retentions in the treating of aspen and jack pine under the following conditions: (1) Posts cut during summer and early fall seasons, (2) treatment started within 7 days after cutting trees, (3) temperatures above freezing.

Although the experience is limited, an average life of 8.5 years is estimated from 4 tests of birch and southern pine posts treated with either zinc chloride or copper sulfate by end diffusion while the average life of untreated posts of these woods was 4.4 years. Of 5 species treated with zinc chloride and tested in Mississippi, posts of slash pine and red oak are in serviceable condition after 4 years while those of sweetbay, sweetgum, and tupelo are estimated to have an average life of from 3 to 4 years.

The advantages and disadvantages of end-diffusion treatment can be summed up as follows:

Advantages	*Disadvantages*
Low first cost.	Protection limited.
Peeling not necessary.	Results of treatment not uniform.
Preservative may be bought and shipped dry or in concentrated form.	Water-borne preservatives subject to leaching.
Requires little equipment.	
Does not call for surplus of preservative.	
Can be used conveniently for small batches of posts.	

Double Diffusion

The Forest Products Laboratory has developed a double diffusion treatment consisting of successively soaking green peeled posts in water solutions of chemicals that diffuse into the moisture of the wood and react to form and deposit chemical compounds having high resistance to leaching (washing out). For example, the posts may be steeped for a few days in a strong solution of copper sulfate and then for a few days in a strong solution of sodium chromate to deposit insoluble copper chromate in the wood. Simple but complete details for this treating method are given in Report 1955, "How To Treat Wood by Double Diffusion," obtainable from the Forest Products Laboratory.

The treatment is relatively inexpensive. Estimated costs are from 15 to 30 cents per post of average size.

Of one group of 100 pine posts treated full length and installed in Mississippi in 1941, only 1 showed failure in 1955. In later installations, posts treated by submerging only the butt end have been performing less satisfactorily than those treated full length.

Tire-Tube Treatment

Tank soaking treatments, except for end-diffusion treatments, are somewhat wasteful of preservative since they end up with leftover preservative. A treating method that gets you away from most of this loss is the so-called tire-tube treatment with water-dissolved preservatives as developed by the Forest Products Laboratory. This consists in setting posts on a slant, butt end up, with sections of old truck tire inner tubes slipped over the upper end, pouring a measured amount of zinc chloride solution into the supported tubes, and letting gravity force the solution lengthwise through the post, to replace the sap with treating solution. The method works only with green, round posts with the bark still on. It does not work with split or sawed posts. The posts preferably should be treated soon after cutting.[8]

The tire-tube treatment has been in use for approximately 12 years and service tests on 15 installations of posts indicate an average life of 10.7 years.

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[8] Complete details of the tire-tube treatment are available in Report No. 1158, Tire-Tube Method of Fence Post Treatment, which can be obtained free from the Forest Products Laboratory, Madison 5, Wis.

Capping, Stepping, and Banding

Another set of methods for introducing zinc chloride and other preservatives in water solutions into trees, posts, and poles has been worked out by the Agricultural Research Service of the U. S. Department of Agriculture. These methods involve the use of caps (like the tube reservoir of the tire-tube method) or bands of rubber under which the preservative is introduced into freshly cut round timber, or placing the butts of small trees from the stump into a container (stepping) to absorb the preservative.[9] The life to be expected is about the same as for the tire-tube or end-diffusion methods. The treatments have not been in use long enough on fence posts, however, to show conclusive service records.

Steeping Treatment

Another low-cost method of using water-dissolved zinc chloride to treat farm timbers is the simple tank steeping method. In this treatment either green or seasoned peeled posts or timbers are soaked for 1 or 2 weeks in unheated 5-percent zinc chloride solution. When time is very limited, the soaking period can be shortened to 3 days with fair results, but the longer treating times are better.

As with other methods of treatment, the results of steeping vary with different woods and with different exposure conditions. Posts of woods such as hickory, southern red oak, sweetbay, sweetgum, and water tupelo have not shown a significant increase in life as a result of steeping in zinc chloride, particularly when tested under warm moist climatic conditions. Southern yellow pine posts similarly treated are performing somewhat better under these conditions. Western redcedar posts last reasonably long without treatment and no significant increase in service has been noted in posts of this species treated by steeping in zinc chloride. Treatment by steeping has been found to be definitely beneficial in the case of round posts of ash, jack pine, lodgepole pine, ponderosa pine, red pine, and Scotch pine tested in Wisconsin, Nebraska, and Montana. Posts of various species treated by steeping and included in 43 different installations have an estimated average life of 15.8 years.[10]

Chemicals in Bored Holes at the Ground Line

A diffusion method reported to be used successfully in some areas consists of boring several downward slanting ½- to ¾-inch-diam-

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[9] Detailed information on these treatments is available in U. S. Department of Agriculture Circular No. 717, Chemical Impregnation of Trees and Poles for Wood Preservation. May be consulted in libraries.

[10] Report No. R621, Preservation of Timber by the Steeping Process, that tells how the steeping treatment should be done and also how various batches of steeped posts have stood up so far in use, can be obtained from the Forest Products Laboratory, Madison 5, Wis.

eter holes in a post at the ground line. The holes are filled with a mixture of about equal parts by weight of white arsenic, mercuric chloride, and common salt and then plugged with corks. **Be sure to note, however, that arsenic and mercuric chloride are highly poisonous to persons and farm animals.**

Douglas-fir test posts treated by this method and field tested by Oregon State College, Corvallis, Ore., are reported to be serviceable although badly rotted in the tops after 21 years of service. Three out of 25 lodgepole pine posts have failed in the same test after 11 years of service. Boxelder, black cherry, American elm, shagbark hickory, and red oak posts treated by this method and tested in Wisconsin have shown some failures in 5 years of service, but slippery elm and white oak posts have shown no failures in this time.

Ground line treatments cannot be recommended for use where climatic conditions favor early decay in the untreated tops of the posts.

Dipping Process

The dipping process gives only limited protection from decay, and it can be used to advantage only with preservative oils and with wood that does not require a high degree of protection. Dipping is commonly used in the treatment of window sash and other millwork with water repellent preservatives where the decay hazard is not severe. When wood is treated by dipping in high-cost preservatives the preservative cost alone may exceed the cost of a more thorough pressure treatment with a standard or low-cost preservative. A retention of 1.5 pounds per cubic foot as noted in dipping 2- by 4-inch sapwood southern pine would be equivalent to approximately 18 gallons of preservative, weighing 7 pounds per gallon, per thousand board feet. At $1.50 or higher price per gallon, as in the case of small purchases, the preservative cost per thousand board feet would be $27, a cost comparable to that of pressure treating wood with standard water-borne preservatives.

In dipping, the wood is simply immersed in the preservative for from a few seconds up to 15 minutes. The preservative may or may not be heated but usually is not. The penetration and absorption of preservative are usually slight in comparison with those obtained in impregnation treatments. On account of the small quantity of preservative used, dipping is much cheaper with preservatives of similar cost than the hot-and-cold-bath or cold soaking treatments, but it is also much less effective. Under no circumstances should any but thoroughly peeled, well-seasoned timber be used.

The equipment required for dipping is a tank. A drain pan may also be used to advantage next to the treating tank to collect surplus preservative as it drains from the treated wood.

In 6 different tests of aspen and pine posts treated by dipping in recognized preservatives such as coal-tar creosote, the estimated average life of the posts is 5.6 years; the average life of untreated posts of these woods was 3.1 years.

Brushing

Brushing is also considered suitable only for preservative oils. It is generally advisable to apply two coats of the preservative by flooding rather than brushing it over the wood surface. The oil should be heated if it is not sufficiently fluid at the prevailing temperature. Special care should be taken to fill every check and crevice in the wood and to apply the preservative liberally to the end grain. The first coat should be allowed to dry completely before the second coat is put on.

The advantages of the brushing method over the others are its simplicity and the small quantity of preservative that is used. Sapwood pine 2 by 4 inches treated by brushing two coats (with creosote) showed a retention of 0.76 pound per cubic foot or about one-half that resulting from dipping 3 minutes in the same preservative. Brushing requires little equipment and you need have no excess of preservative left over after the wood is treated. Brushing is more time-consuming than dipping, however, and is therefore more costly. You will find it of value in treating parts of large sticks if they cannot be tank treated, and in treating timber at joints and all points of contact where decay is likely to occur. As mentioned before, brushing or dipping adds less to decay resistance than do the other treatments that result in real penetration.

Like dipping, the brushing method is suitable only for use on peeled, thoroughly seasoned, and dry timber. It is best to use it in warm weather. In cold weather, the preservative is cooled and penetrates less readily. Penetration in any event will be shallow.

The apparatus for treatment consists only of a pail and a suitable brush. A small soft broom might be substituted for the brush if desired.

Although brush applications of preservatives are often beneficial when the wood is not used where it is likely to be moist for long periods, service tests on posts indicate that the treatment has doubtful value when applied to wood used in contact with the ground. In 10 tests of posts of various species such as Douglas-fir, red oak, white oak, northern white-cedar, lodgepole pine, and spruce, the estimated average life of the treated posts is only 9.5 years while the average life of untreated posts of these woods is approximately the same. Of these 10 tests only 1 showed a definite increase in post life due to the brush treatment.

THE COMMON PRESERVATIVES

Coal-Tar Creosote

Coal-tar creosote, which is a brownish-black heavy oil, practically insoluble in water, is the most widely used preservative. Its advantages are (1) high toxicity against decay fungi and insects; (2) permanence under a wide variety of conditions, including use in fresh and salt water; (3) ease of determining the depth of penetration in treated wood; (4) freedom from corrosive action on metals and wood; and (5) comparatively low cost when bought

in large quantities. The disadvantages of creosote are (1) its odor, which is often objectionable in buildings and around foodstuffs; (2) its oily nature and the tendency of wood treated with it to bleed, which makes the treated wood objectionable to handle and difficult to paint over; (3) its irritating effect on the skin of some workers, particularly those of light complexion; and (4) its complicated and variable chemical composition.

The lighter, more easily evaporated oils of creosote that are present in treated wood until it has been in use for some time may permit the treated wood to catch fire more easily than untreated wood. After these light oils have evaporated from the wood or have been removed by weathering the wood may actually be less likely to catch fire than untreated wood.

Coal-tar creosotes vary considerably in quality; but satisfactory results may be obtained from any good grade, provided enough is put into the wood and the wood is well penetrated. Creosotes containing a high percentage of oils which boil at a comparatively low temperature are not so suitable for use on the farm as those which contain less of these oils, because a considerable part—perhaps up to 20 percent—may evaporate during treatment. This loss of oil may be largely offset, however, by the lower prices for low-boiling creosotes. The increase in price that can be economically paid for the higher boiling creosotes will in general not be more than 25 to 35 percent. Usually, when considerable creosote is needed, it can be bought to meet specifications. Quality specifications for coal-tar creosote have been set up by the U. S. Government and the American Wood Preservers' Association.

Anthracene Oils (Carbolineums)

Carbolineums (anthracene oils) are coal-tar products that are heavier and contain less low-boiling (easily evaporating) material than ordinary coal-tar creosote. They usually cost more but this is offset to some degree by the absence of the low-boiling materials that cause some loss through evaporation. The carbolineums are usually sold under trade names. Their properties and effectiveness as preservatives are similar to those of creosote.

Wood-Tar Creosotes

Wood-tar creosotes, made from wood tar rather than coal tar, are not produced in large quantities and for this reason have not been so widely used. When of good quality and thoroughly applied they have good wood-preserving properties, but service tests show them to be less effective than coal-tar creosote.

Coal Tar

Coal tar is not a good preservative for farm use because it is not so poisonous to decay fungi as creosote and does not penetrate wood well.

Water-Gas Tar and Water-Gas-Tar Creosote

Water-gas tar, a product coming from the petroleum oils used in making water gas, is a good low cost preservative although not

readily obtainable. It should be reasonably free of water otherwise foaming can be expected during heating. The tar should also not be too viscous to penetrate the wood. Water-gas-tar creosote is also a good preservative although it is not so poisonous to fungi as coal-tar creosote; but it is effective if the wood is well penetrated and retains good quantities of the preservative.

Creosote Mixtures

Coal-tar creosotes are usually so poisonous to decay fungi that they can be diluted with less effective oils and still give good protection to wood. In cases where the cost of straight creosote places it out of reach it may be mixed with as much as an equal amount of cheaper oils, and many treatments have been made with such mixtures. For reasons of cost and supply the heavier petroleum oils have been employed by large users of treated wood such as the railroads. Creosote solutions containing the heavier petroleum oils have had a good record of performance with cross ties. Creosote solutions made with domestic fuel oil, because of their low viscosity, have been used in the cold-soaking process. Information is lacking, however, on the effectiveness of these solutions with lighter domestic fuel oils and the user should not anticipate the service that he can expect from wood treated with straight creosote.

The heavier oils and the coal tars, water-gas tar, and water-gas-tar creosote, which are sometimes mixed with creosote, may not penetrate wood so readily as straight creosote. In such case they can be recommended only for woods that are penetrated readily and for treatments involving heating that are carefully managed to insure good penetration.

Tar mixtures, when applied as treatments, leave the wood with a black, gummy coating that makes it objectionable to handle in post form, although this condition is not considered a handicap in such items as railroad cross ties.

Creosote-petroleum solutions are naturally less poisonous to fungi than straight creosote, in most cases even less poisonous than the proportion of creosote in the mixture would indicate. Frequently, during periods of creosote shortage, petroleum oils added to creosote have been fortified with pentachlorophenol or copper naphthenate to maintain the effectiveness of the mixture. Some mixtures of creosote and petroleum oil cause a sludge which interferes with penetration and may block pipe lines and pumping systems. This sludge should be allowed to settle after thoroughly stirring the mixture and then should be removed.

Pentachlorophenol

Some years ago it was pointed out at the Forest Products Laboratory that the higher chlorinated phenols were very poisonous to wood-destroying fungi. Field tests on stakes and posts started in 1936 indicated one of these chemicals, pentachlorophenol, to provide good protection against decay and termites, and since 1945 this preservative has come into fairly wide use in the treatment of telephone and power line poles.

The chlorinated phenols were first used in quickly evaporating solvents, such as mineral spirits, for dipping treatments of window sash and millwork where a clean nonswelling and paintable treatment was required. Although there has not been time to carry service tests far enough to yield final answers, a great deal of wood has been treated with various oils containing pentachlorophenol on the basis of the early favorable results in post and stake tests. The oils used have ranged from the mineral spirits type to the heavier oils commonly used in commercial creosote-petroleum solutions. The Diesel-type oils are often employed in solutions of pentachlorophenol used in the cold soaking and hot-and-cold-bath processes.

Pentachlorophenol is available in three forms—dry flake, concentrated solution, and ready-to-use solution. When bought dry it is in the form of dark gray flakes or crystals having a slight odor. When handled in this form, the chemical has a tendency to give off dust. The dust is irritating to the eyes, nose, and throat, so that the use of goggles and dust masks is recommended for anyone mixing the solution. Special heating and agitating equipment along with a knowledge of the solubility and other properties of the solvents used is ordinarily needed in making solutions from the dry chemical.

It is generally easier for the user without special mixing equipment to buy either a ready-to-use solution or a concentrated solution of pentachlorophenol and dilute it with the desired oil. Concentrates are available calling for mixing with 2 to 12 or more parts of solvent (by volume) to make a 5-percent solution. Concentrates are either dark or light colored depending on the use for which they are intended and the strength of the pentachlorophenol in the concentrate. Light-colored concentrates usually contain less preservative than those that are darker. To meet special requirements as to color, paintability, and heating, pentachlorophenol solutions should be selected carefully and the supplier of the preservative should furnish information as to suitable petroleum diluents.

Copper Naphthenate

Copper naphthenate is supplied either in ready-to-use solutions or in the form of a concentrated solution for mixing with petroleum oils to make effective treating solutions. Copper naphthenate, on the basis of stake tests, provides good protection against decay and termites when thoroughly applied to the wood and when used in petroleum oil solutions containing a copper metal equivalent of at least 0.5 percent. For nonpressure treatments, a copper metal equivalent of not less than 1.0 percent is recommended.

Zinc Chloride

The principal advantages of zinc chloride are relative cheapness, uniformity of quality, cleanliness, lack of odor, ease of shipment, and lack of fire hazard. Its chief disadvantage is its tendency to leach out of wood in contact with water or soil. The water that is

added to wood with the preservative adds considerably to its weight and, in order to avoid shrinkage troubles, must be dried out before the wood is used in buildings.

When injected into wood in the usual amounts (a pound to one and a half pounds per cubic foot) zinc chloride has a slight effect in reducing flammability. However, a higher retention of 3 pounds of the salt per cubic foot does have a considerable effect in reducing flammability.

Zinc chloride is shipped either in the solid form (fused or granulated) or in concentrated solutions. When the freight haul is not too great, the concentrated solution, usually about 50-percent strength, is shipped in drums or tank cars. For long freight hauls, the salt is shipped in solid form in air-tight drums. The air-tight containers are necessary since solid zinc chloride attracts moisture from the air. For use in treating wood, water solutions of 3 to 20 percent (by weight), depending on the process used, are prepared from the concentrated material.

Chromated Zinc Chloride

Chromated zinc chloride is a wood preservative developed by a manufacturer of zinc chloride on the basis of experiments by the Forest Products Laboratory and intended as an improvement over straight zinc chloride. It has been in use since 1934. It is usually sold in the granular form containing approximately 18 percent commercial sodium bichromate and 82 percent commercial zinc chloride.

Chromated zinc chloride is claimed to be more resistant to leaching than zinc chloride, to give equal protection against termites, and greater protection against decay although tests on posts do not always support these claims. It is known that chromium salts do not leach readily from wood.

Proved Trade-Name Preservatives

There is available a group of patented preservatives designed and promoted by their manufacturers for effective treating procedures, principally pressure impregnation. Forest Products Laboratory Report R149, Wood Preservatives, describes some of these preservatives that have been standardized. A number of these preservatives, on the basis of performance of wood treated with them to date, have qualified as efficient wood preservatives.

Materials of Low Preservative Value

Crude petroleum, fuel oil, and gas oil, have been used in many tests. The results show that petroleum oils used alone do not in general stop decay fungi. They cannot be recommended unless they are mixed at least with an equal quantity of creosote or are fortified with a good oil-soluble preservative such as pentachlorophenol or copper naphthenate.

You cannot prevent decay by applying paint, linseed oil, whitewash, asphalt, water repellents, or similar coatings to fence posts or other timber in contact with the ground. These materials do not penetrate the wood deeply, and as a rule they are not poisonous

to wood-rotting fungi. Some people believe that coatings can prevent decay by preventing fungi or moisture from getting into the wood, but no economical coating is known that comes near doing this. Wood is seldom painted on all sides, so usually you will find moisture and the fungi getting in through an unpainted part. Furthermore, the spores of fungi are commonly present on wood surfaces or can get to the wood whenever the painted film cracks or peels off. Tests have shown many times that paint films do not prevent moisture changes, but merely slow them up. It is quite common to see wood decaying beneath a coat of paint.

HANDLING POSTS BEFORE AND AFTER TREATMENT

Culling Posts That Already Show Decay

In some parts of the country, under warm moist conditions, it is difficult to season posts in the summer without some mold and decay taking place. This will result in excessive absorption of the preservative so that the treatment may be too costly to be economical. Treatment with preservative after decay has developed furthermore will not repair the damage and if the wood is not treated all the way through, decay may still go on in spite of the preservative in the outer shell of wood. It is seldom advisable to treat rotted wood but necessity sometimes justifies the treatment of posts where the decay has not progressed to the point of "punkiness" or obvious strength reduction.

Time of Cutting

There are advantages to cutting trees for post use in the late fall or winter. The bark peels best in the spring and early summer, but seasoning in the summer is likely to be so rapid that it may result in severe checking. In warm weather, wood carelessly piled or handled may start to rot very quickly or be attacked by insects. Timber cut in the late fall or winter usually seasons more slowly and with less checking than during the warmer months. Wood-rotting fungi and insects do not attack wood out of doors in cold weather, and by the time warm weather begins the wood, if peeled, usually has dried enough to avoid decay. For posts to be treated by end-diffusion methods, however, cutting during the summer and early fall months is desirable from the standpoint of improved treating results.

Peeling

Posts to be treated by the tire-tube method, capping, stepping, steeping, end-diffusion or by boring holes at the ground line need not be peeled. They may or may not be peeled after treatment although better performance can be expected in some cases by peeling after treatment, particularly with a ground line treatment. All other timber for treatment should be peeled before preservative is applied.[11] In peeling posts care should be taken to remove

[11] Report No. D1730, Bark-Peeling Machines and Methods, can be obtained from the Forest Products Laboratory, Madison 5, Wis., by those interested in peeling posts by mechanical means.

the thin inner bark from the part of the post that is to be treated. Even small patches of this inner bark can prevent penetration by the preservative, leaving a zone of unprotected wood open to decay. The value of the treatment depends on having all the wood well protected. In the seasoning of round posts a condition known as surface hardening sometimes occurs which retards penetration of the preservative. Removal of this thin layer will sometimes improve the treatment.

Seasoning and Piling

To obtain the best absorption and penetration of preservative with most treatments, posts must be seasoned before treatment. This is true, of course, with the exceptions noted regarding diffusion treatments, capping, stepping, and banding, the tire-tube treatment and other treatments on green wood. Further, for posts to be given treatments other than the ones just referred to, the water (sap) must be gotten out to make room for the preservative to go in. Posts that are not adequately seasoned before treatment are also likely to check or crack after treatment, thereby admitting infection to the untreated wood below the surface.

The best place for good seasoning is an exposed location on high, well-drained ground. On damp or low ground seasoning will be slower, and the wood will never get quite so dry. If properly piled in a good location, posts will usually season enough for treatment in from 30 to 60 days of good seasoning weather. Sometimes they will season adequately in less than a month.

Posts should be open-piled for seasoning, so that air will circulate freely around each one. The bottom of the pile should be raised at least a foot above the ground (fig. 8). Posts should never be

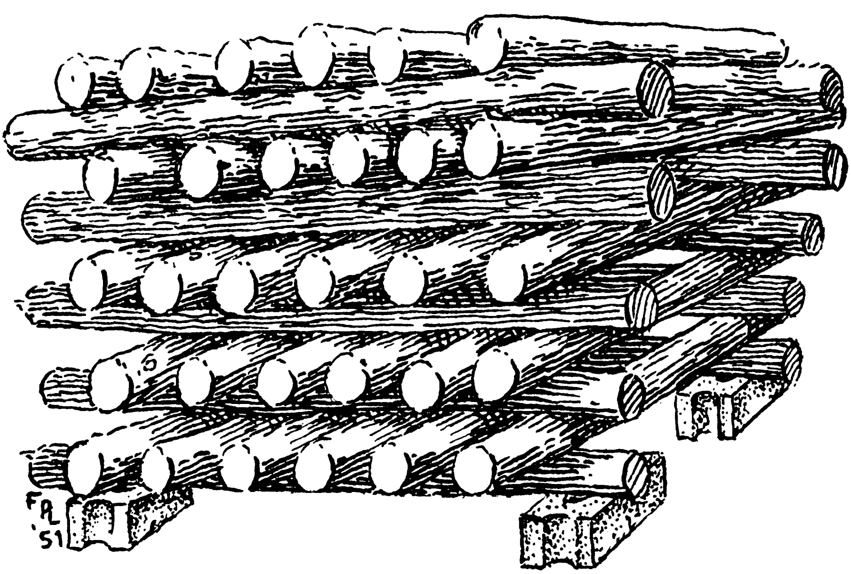

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FIGURE 8.—Posts well piled for seasoning.

close-piled or allowed to lie or stand on the ground before treatment, under such conditions they may start to decay before they are seasoned. No method of piling is satisfactory that permits any part of the post to rest on the ground.

By weighing a few typical posts at regular intervals it is possible to tell the degree of seasoning very closely. When an ordinary-sized post properly peeled and piled for seasoning does not lose more than a pound or two in a week of dry weather it may be figured as ready to treat.

But remember, *seasoning isn't permanent.* A fence post that is dry as a result of seasoning is safe from decay only so long as it stays dry. If a post is not to be treated, it makes no difference in the long run whether it is put into the ground green or seasoned. It will in time take on or give off moisture to come to a balance with the moisture in the soil and surrounding air. From there on the soil and air moisture, temperature, and kind of wood tell the story of how long the post will last.

Wood suffers no decay damage from being thoroughly wet and dried out if the drying takes place before rot fungi can start to grow. It is wood that becomes damp and remains so over considerable periods that rots.

Controlling Checking

Some woods, such as oak, check very badly when dried too rapidly. It is a good thing, if possible, to cut and peel such timber in the fall or winter, so that by the time warm weather comes it will be partly seasoned. The pines, firs, and other cone-bearing woods are usually not checked so seriously as the oaks by rapid seasoning. For the woods that check readily it will help to make the seasoning piles in partial shade and paint the ends of the posts with a good end coating. Forest Products Laboratory Technical Note No. 181, Coatings for Minimizing Changes in the Moisture Content of Wood, contains information on end coatings. The painted post ends should be trimmed off before treatment.

Sawing and Framing

Sawing, framing, notching, or any other cutting operation on posts or timbers may be done at any time during the preparation of the wood for treatment. However, to keep unbroken the armor of treated wood on the outside of the pieces you are treating, all sawing and framing should be done before treatment if at all practical. If cutting through the treated zone after treatment cannot be avoided, the exposed untreated wood should be brushed with several coats of hot creosote or other good oil-type preservative. This will not protect the area to the degree that the rest of the wood is protected, but it will be of some help.

Care After Treatment

You can make your own rules for handling timber after treatment on the basis of what you know about decay and the importance of keeping unbroken the shell of treated wood that has been created on the outside of timbers. All handling and piling should be conducted accordingly.

If butt-treated posts or other timbers of which only a part is treated are not to be used for some time, they should be open-piled after treatment. If they are close-piled or allowed to lie on the ground for a considerable length of time, decay is likely to start in the untreated parts. If the timber is treated full length with preservative oils, it should be close-piled until used. In the case of material treated with water-borne preservatives that require seasoning prior to use, the timber should be stacked for seasoning in open piles.

In setting butt-treated posts, piles, and other end-treated timbers great care should be used to avoid setting them too deep. At least 6 inches of treated wood—more if convenient—should be above the ground after the posts are set. Otherwise they are liable to decay injury above the treated part.

PAINTING OVER TREATED WOOD

The user frequently wants to improve the appearance of treated structures such as fences, farm buildings, trellises, and porch steps by painting with exterior paints. Creosoted wood and wood containing other oils offer difficulties in painting. Wood treated with water-borne preservatives can be painted satisfactorily after it has been seasoned to remove the water added during treatment. Wood treated with volatile oils containing pentachlorophenol can also be painted if enough time is allowed after treatment for the removal of the oils or solvents in the treating solution.

JUDGING TREATED POSTS

An ideally pressure-treated post would have the sapwood treated all the way through. Standards on pressure treatment, however, generally require penetration to a depth of not less than 85 percent of the thickness of the sapwood and a minimum retention of 6 pounds of coal-tar creosote or its equivalent per cubic foot of post. Such results may be difficult to attain in the nonpressure treatments although they are worth striving for when maximum protection is desired. Early failures in treated posts frequently can be traced directly to poor penetration of the preservative.

Inspectors of treated wood use a special tool called an increment borer to determine the depth of penetration of a preservative. Individuals who do not have such a tool can cut up and split an occasional post and determine the depth of penetration from the freshly split section. An ordinary brace and bit can often be used to show the depth of penetration. In this case examination should be made immediately and the hole should be tightly filled with a treated wood plug. The penetration of preservative should be observed at the ground line of posts since it is at that zone that the protection of the preservative is most needed.

OTHER FARM TIMBERS

Fence posts are only one item among the timber structures on the farm that go bad and have to be repaired or replaced because of

rot. Repairs and replacements that must be made to keep the farm operating cost money. Those that can be let go may result only in sagging or leaning of sheds, barns, and cribs due to rotted timber joints or sills. These failures may or may not be repaired promptly. Even when it is possible to delay dealing with them, they take something away from farming as a way of life.

Timbers other than fence posts may call for longer tanks than posts and hence a farm treating plant for them may be difficult to improvise. Such timbers when untreated are subject to rotting in many farm situations and the decay fungi grow in them in the same way as they do in fence posts and can be controlled by similar treating measures and by carefully selecting the preservative to meet use requirements.

Joints Are Danger Spots

Wherever two wood surfaces are joined in an outdoor structure there is apt to be a crack into which moisture may drain or which will hold moisture long after surrounding areas have dried out. Cases in point would be the spots where stringers meet on a post top or where they are bolted to the side of a post, or where knee braces meet and are bolted to a column. These are spots where decay can often be found. Frequently some replanning of the structure will do away with water-collecting cracks or pockets. For instance, the diagonal bracing and horizontal members on a garage door can be moved to the inside of the door structure.

Sills and Foundation Timbers

Sills and foundation timbers are probably as liable to decay as fence posts. In some locations they may even be subject to rotting during a longer portion of each year, since temperatures will be more favorable to fungi in a structure housing animals than in the open fields. As in the case of posts the big hazard is contact with the ground. When replacement is likely to be difficult and costly for foundation timbers, emphasis should be placed on thorough treatment so that they will give maximum service. This is particularly a good rule to follow in case of wood poles to be used in the newer type of pole construction (fig. 9) in farm buildings.

Everything that can be said regarding the cutting or framing of posts applies with equal or greater force to sills and foundation timbers. Once treated by any process no avoidable cutting should be done since it is equally desirable that no untreated wood should be exposed.

Bridge Timbers

Treatment of the timbers and planks of permanent farm bridges will add materially to their resistance to decay. Pressure impregnation and hot-and-cold-bath treatments are preferred as in the case of posts. Brush or dipping treatments, particularly of the face of bridge floor planks would be worn away quickly through abrasion and would be of little value.

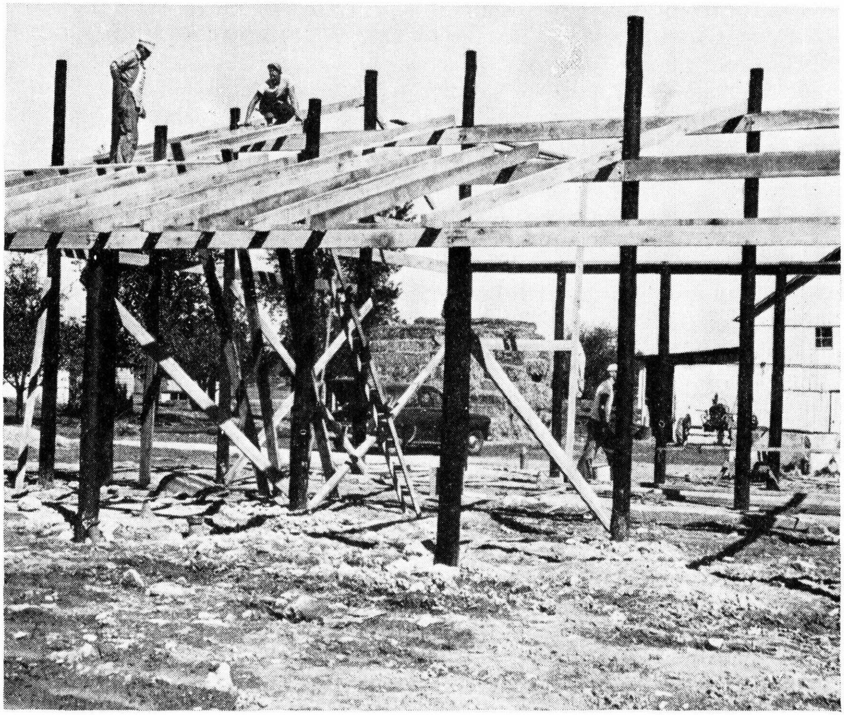

FIGURE 9.—Because of the decay hazards involved and the importance of the poles as structural units in the pole-frame type of construction only pressure-treated poles should be used in pole framing.

Silos

A thorough treatment with coal-tar creosote will make a wood silo more resistant to decay and less subject to shrinking and swelling. It will also make painting unnecessary.

Pressure-treated lumber can often be purchased for silo construction and some manufacturers of silos use wood treated with preservatives. If it is not possible to obtain a treated or durable wood silo through these channels and if there is no treating plant to which untreated staves could be hauled for treatment, one of the open-tank treatments will be the next best thing. All untreated surfaces necessarily exposed by cutting should be heavily painted with a preservative.

Experience has shown little danger of contamination of silage by creosote if care is used. Other standard preservatives are also not thought to be objectionable from this standpoint. The absorptions of preservative should not exceed 8 or 10 pounds per cubic foot of wood for preservative oils or those normally specified for water-borne preservatives. The treated wood should be exposed to the weather for several weeks in open piles before it is put into the silo.

Of the woods in general use for silo construction the pines are, as a class, the most easily treated; the hemlocks, western larch, the spruces, and Douglas-fir are somewhat more difficult. Redwood is frequently used without treatment. With pressure treatment the greatest saving can usually be made by using the cheaper woods, as the difference in the lasting qualities of the various kinds of wood is less after treatment than before. It is doubtful that the treatment of such durable woods as heart redwood or heart baldcypress would pay.

Shingles

Shingles of the less durable woods can be dip treated to advantage when they are to be used for walls. For use in roofs a better treatment, such as the hot-and-cold-bath method, is desirable. This treatment can be combined with staining if it is desired. Descriptions of both staining and preservative treatment for shingles, with stain formulas, are found in U. S. Forest Products Laboratory Report R761, The Preservative Treatment and Staining of Shingles.

WHERE TO LOOK FOR HELP WITH YOUR TREATING

Advice on farm timber preservation problems is given by the representatives of numerous organizations. Information on commercial wood preserving treatments can be obtained from the Service Bureau of the American Wood Preservers' Association, Chicago, Ill. For information on preservatives and their application logical persons to consult are county agents, extension foresters, soil conservation officers, and members of the Forest Utilization Service units located at the various Forest Experiment Stations of the U. S. Forest Service. Organizations likely to supply information include colleges having forest schools, agricultural colleges, State forestry and conservation agencies (usually located at the State capital), the Tennessee Valley Authority, and the U. S. Forest Products Laboratory at Madison 5, Wis. The T.V.A. and some State agencies occasionally hold demonstrations or even provide treating facilities at reasonable costs in some rural localities.

The possibilities of purchasing treated posts and lumber or of treating timber locally by nonpressure methods so as to make it pay real dividends are greatly increased by group action. The costs of pressure-treated posts are most favorable when orders can be placed for carload lots. Preservatives can usually be purchased at a much more favorable price in carload than in gallon lots. Thus it is highly desirable for farmers to set up formal or informal cooperating units in making purchases so as to get the benefits of quantity buying. Such units also help to lower equipment charges against the treated material and lighten the work load. Some of the extension agencies mentioned are interested in helping to form such treating cooperatives.

U. S. GOVERNMENT PRINTING OFFICE: 1956

For sale by the Superintendent of Documents, U. S. Government Printing Office
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PREVENT FARM FIRES

Fires kill more than 3,000 farm people each year, and cause painful injury to many thousands more.

In farm homes fire is the main cause of death and injury among younger people.

Each year fires destroy $133,000,000 worth of farm property.

Much of this loss and suffering can be avoided by taking precautions to prevent fires or by being prepared to control those that do get started. In making a fire-safety check on your own farm, keep in mind that the primary causes of farm fires are—

- Lightning
- Sparks on the roof
- Defective chimneys or heating systems
- Faulty electric wiring or appliances
- Careless smokers
- Careless use or storage of gasoline, kerosene, oily rags, and such
- Children playing with matches

Don't start any fire unless you know you can stop it.

Keep a fire extinguisher handy and make sure every member of the family knows how to use it.

For details, see U. S. Department of Agriculture Farmers' Bulletin No. 1643, Fire Safeguards for the Farm.

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